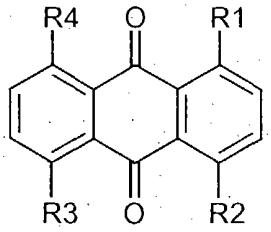
What is claimed is:

1. A pharmaceutical compound according to Formula I,




FORMULA I

wherein R1, R2, R3 and R4 are selected from the group consisting of a straight or branched chain alkyl group having 1 to 6 carbons substitutes with one or more Ra groups, a benzyl group, a phenyl group which is substituted with one or two Rb groups, and a benzyl group which is substituted with one or two Rb groups;

wherein R1, R2, R3 and R4 are selected from the group consisting of halogen, $-NO_2$, $-OCH_3$, $-OCH_2CH_3$, $-CH(CH_3)_2$, $-(CH_2)_nOH$, $-(CH_2)_nNH$, $-CH_2CH_2N(CH_3)_2$, $-CH_2CH_2NH(CH_2)_2OH$, cyclopentane, 2,3-$(CH_3)_2$-cyclohexane, -S-Rc, -O-CO-Rd, -N-Re, -CO-Rf, -CONH-Rg; and

wherein Ra, Rb, Rc, Rd, Re, Rf, Rg are selected from the group consisting of a straight or branched chain alkyl group having 1 to 6 carbons, $-NO_2$, $-OCH_3$, $-OCH_2CH_3$, $-CH(CH_3)_2$, $-(CH_2)_nOH$, $-(CH_2)_nNH$, $-CH_2CH_2N(CH_3)_2$, $-CH_2CH_2NH(CH_2)_2OH$, cyclopentane, 2,3-$(CH_3)_2$-cyclohexane, -S-, -OCO-, -N-, -CO-, -CONH-.

2. The compound according to claim 1, wherein R1, R2, R3 and R4 represent a substituted phenyl, benzyl, ethylphenyl, cyclopentane, and 2,3-$(CH_3)_2$-cyclohexane groups selected from the group consisting of 2-$CH_3C_6H_4$, 3-$CH_3C_6H_4$, 4-$CH_3C_6H_4$, 2-$OHC_6H_4$, 3-$OHC_6H_4$, 4-$OHC_6H_4$, 2-$ClC_6H_4$, 3-$ClC_6H_4$, 4-$ClC_6H_4$, 2-$NO_2C_6H_4$, 3-$NO_2C_6H_4$, 4-$NO_2C_6H_4$, 2-$NH_2C_6H_4$, 3-$NH_2C_6H_4$, 4-$NH_2C_6H_4$, and 2,4-$Cl_2C_6H_3$.

3. The compound according to claim 1, wherein R1, R2, R3 and R4 represent a substituted alkyl group selected from the group consisting of $CH_2Br$, $CH_2Cl$, $CH_2OH$, $C(CH_3)_3$, $(CH_2)_2OH$, $(CH_2)_3OH$, $(CH_2)_4OH$, $CH_2NH_2$, $(CH_2)_2NH_2$, $(CH_2)_3NH_2$, $(CH_2)_4NH_2$, $(CH_2)_5NH_2$, $CH_2N(CH_3)_2$, $(CH_2)_2N(CH_3)_2$, $(CH_2)_2NH(CH_2)_2OH$, $(CH_2)_3NH(CH_2)_2OH$, $(CH_2)_2NHCH_2OH$, $(CH_2)_3NHCH_2OH$, $CH_2CH(CH_3)_2$, $CHCl_2$, $CH(CH_3)Cl$, $(CH_2)_2Cl$, $(CH_2)_3Cl$, $(CH_2)_3Br$, $(CH_2)_4Br$, and $(CH_2)_4Cl$.

4. An anti-cancer drug, comprising, as an active ingredient, the pharmaceutical compound of claim 1.

5. A telomerase effect drug, comprising, as an active ingredient, the pharmaceutical compound of claim 1.

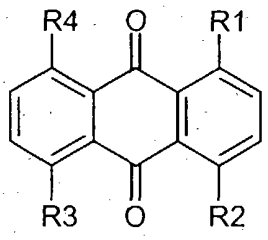
6. An anti-inflammatory drug, comprising, as an active ingredient, the pharmaceutical compound of claim 1.

7. An anti-oxidant drug, comprising, as an active ingredient, the pharmaceutical compound of claim 1.

8. An anti-psoriatic drug, comprising, as an active ingredient, the pharmaceutical compound of claim 1.

9. A stem cell and tissue engineering application, comprising, as an active ingredient, the pharmaceutical compound of claim 1.

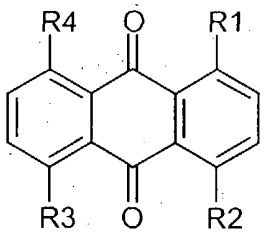
10. A compound having the chemical structure of Formula I,




FORMULA I

wherein R1, R2, R3 and R4 represent cyclopentane, cyclohexane, $-C_6H_5$, $-CH_2C_6H_5$, or $-CH_2CH_2C_6H_5$, group having one, two or three substituents which is selected from the group of halogen, OH, $CH_3$, $OCH_3$, $NH_2$, and $NO_2$.

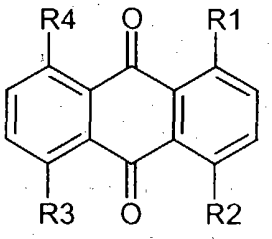
11. A compound having the chemical structure of Formula I,




FORMULA I

wherein R1, R2, R3 and R4 represent -S-, -O-CO-, -N-, -CO-, and -CONH-, consisting of a straight or branched chain alkyl group having 1 to 6 carbons, and $CH_2Br$, $CH_2Cl$, $CH_2OH$, $C(CH_3)_3$, $(CH_2)_2OH$, $(CH_2)_3OH$, $(CH_2)_4OH$, $CH_2NH_2$, $(CH_2)_2NH_2$, $(CH_2)_3NH_2$, $(CH_2)_4NH_2$, $(CH_2)_5NH_2$, $CH_2N(CH_3)_2$, $(CH_2)_2N(CH_3)_2$, $(CH_2)_2NH(CH_2)_2OH$, $(CH_2)_3NH(CH_2)_2OH$, $(CH_2)_2NHCH_2OH$, $(CH_2)_3NHCH_2OH$, $CH_2CH(CH_3)_2$, $CHCl_2$, $CH(CH_3)Cl$, $(CH_2)_2Cl$, $(CH_2)_3Cl$, $(CH_2)_3Br$, $(CH_2)_4Br$, and $(CH_2)_4Cl$.

12. A method for synthesis of bis-substituted anthraquinone compounds and salts thereof, comprising reacting 1,5-dichloroanthraquinone, anthrarufin, 1,8-dichloroanthraquinone, 1,5-diaminoanthraquinone or 1,8-diaminoanthraquinone with an appropriate acyl chlorides, thiols, or amines under appropriate conditions to give the bis-substituted anthraquinones according to Formula I




FORMULA I

wherein R1, R2, R3 and R4 are selected from the group consisting of a straight chain alkyl group having 1 to 6 carbons which is optionally substituted with one or more R groups, a branched chain alkyl group having 1 to 6 carbons which is optically substituted with one or more R groups, cyclopentane, 2,3-$(CH_3)_2$-cyclohexane, $-C_6H_5$, $-CH_2C_6H_5$, or $-CH_2CH_2C_6H_5$, a phenyl which is substituted with one or more R groups, and a benzyl group which is optionally substituted with one or more R groups, and $-CH_2CH_2C_6H_5$ group which is optionally substituted with one or more R groups;

wherein R is selected from the group consisting of halogen, OH, $CH_3$, $OCH_3$, $NH_2$, and $NO_2$.

13. A method for anti-cancer treatment, comprising administering a therapeutically effective amount of a pharmaceutical compounds according to claim 11 or a pharmaceutically acceptable salt of said compound and optionally a pharmaceutical carrier to a patient in need of such treatment.

14. A method for treating abnormal proliferation, comprising administering a therapeutically effective amount of a pharmaceutical compounds according to claim 11 or a pharmaceutically acceptable salt of said compound and optionally a pharmaceutical carrier to a patient in need of such treatment.

15. A method for enhancing an anti-oxidation affect, comprising administering a therapeutically effective amount of a pharmaceutical compounds according to claim 11 or a pharmaceutically acceptable salt of said compound and optionally a pharmaceutical carrier to a patient in need of such treatment.

16. A method for enhancing human telomerase activity, comprising administering a therapeutically effective amount of a pharmaceutical compounds according to claim 11 or a pharmaceutically acceptable salt of said compound and optionally a pharmaceutical carrier to a patient in need of such treatment.

17. A method for stem cell research, comprising administering a therapeutically effective amount of a pharmaceutical compounds according to claim 11 or a pharmaceutically acceptable salt of said compound and optionally a pharmaceutical carrier to a patient in need of such treatment.

18. A method for enhancing tissue engineering application, comprising administering a therapeutically effective amount of a pharmaceutical compounds according to claim 11 or a pharmaceutically acceptable salt of said compound and optionally a pharmaceutical carrier to a patient in need of such treatment.

19. An anti-cancer drug, comprising, as an active ingredient, the pharmaceutical compound of claim 11.

20. An anti-inflammatory drug, comprising, as an active ingredient, the pharmaceutical compound of claim 11.

21. An anti-oxidant drug, comprising, as an active ingredient, the pharmaceutical compound of claim 11.

22. An anti-psoriatic drug, comprising, as an active ingredient, the pharmaceutical compound of claim 11.

23. Drug for telomerase activation or inhibition, comprising, as an active ingredient, the pharmaceutical compound of claim 11.

24. Drug for stem cell application, comprising, as an active ingredient, the pharmaceutical compound of claim 11.

25. Drug for tissue engineering, comprising, as an active ingredient, the pharmaceutical compound of claim 11.

Table 1. Cytotoxicity Against the Growth of Suspended Murine and Human Tumor Cell Lines and Inhibitory Effect of Anthraquinone Derivatives (IIa-k)on Iron-induced Lipid Peroxidation in Rat Brain Homogenates.

| Compound | R | $IC_{50}$ (μM)[a] | | LP (%) (10 mM)[b] |
|---|---|---|---|---|
| | | Hep G2 [c] | C6 cells [d] | |
| IIa | $CH_2CH_3$ | 12.2 ± 1.1 | 0.02 ± 0.01 | 83 ± 2.2 |
| IIb | $CH_2CH_2OH$ | 36.4 ± 1.5 | 21.5 ± 0.8 | 16 ± 2.2 |
| IIc | $CH_2CH_2CH_3$ | 75.1 ± 2.5 | 29.9 ± 2.1 | 15 ± 1.5 |
| IId | $CH_2CH(OH)CH_2OH$ | 34.3 ± 1.8 | 38.5 ± 1.5 | 83 ± 1.1 |
| IIe | $(CH_2)_6OH$ | 49.3 ± 2.1 | 31.7 ± 1.6 | 54 ± 1.9 |
| IIf | $2\text{-}NH_2C_6H_4$ | 34.0 ± 1.7 | 15.1 ± 1.7 | 5 ± 0.5 |
| IIg | $3\text{-}NH_2C_6H_4$ | 21.5 ± 1.2 | 26.3 ± 2.8 | 6 ± 0.9 |
| IIh | $4\text{-}NH_2C_6H_4$ | 17.4 ± 1.5 | 0.05 ± 0.01 | 20 ± 1.4 |
| IIi | $CH_2C_6H_5$ | 41.5 ± 2.5 | 38.2 ± 4.4 | >100 |
| IIj | $CH_2C_6H_4(OCH_3)(p)$ | 28.6 ± 1.2 | 25.1 ± 2.8 | 67 ± 2.9 |
| IIk | $CH_2CH_2C_6H_5$ | 36.9 ± 1.5 | 32.9 ± 3.3 | 69 ± 1.5 |
| | Mitoxantrone | 2.0 ± 0.5 | 0.07 ± 0.01 | 54 ± 1.5 |
| | Ascorbic acid | | | >100 |
| | (+)–α-Tocopherol | | | >100 |
| | Anthrarufin | | | -36 ± 1.9 |

[a]$IC_{50}$, drug concentration inhibiting 50% of cellular growth following 48 h of drug exposure. Values are in μM and represent an average of three experiments. The variance for the $IC_{50}$ values was less than ± 20%. Inhibition of cell growth was significantly different with respect to that of the control; $n = 3$ or more, $P < 0.01$. [b]Relative percentage of inhibition. Inhibition was compared with that of the control (ascorbic acid, α-tocopherol and mitoxantrone-HCl), $P < 0.01$, mean ± S.E., $n = 4$. Values are mean percent inhibition at the indicated concentration (μM), and standard errors. [c]Hep G2, human hepatoma G2 cells. [d]C6 cells, rat glioma C6 cells.

Table 2. Inhibitory Effects of IIi on Iron-induced Lipid Peroxidation in Rat Brain Homogenates.

| Compound | Inhibition (%)[a] | | | |
|---|---|---|---|---|
| | 10 mM | 1 mM | 0.1 mM | 0.01 mM |
| IIi | >100 | 95 | 60 ± 2.0 | 24 ± 0.8 |
| Ascorbic acid | 100 | 75 ± 1.5 | 32 ± 1.2 | 10 ± 0.6 |
| (+)-α-Tocopherol | 100 | 55 ± 1.7 | 0 | 0 |
| Mitoxantrone-HCl | 100 | 54 ± 2.1 | 22 ± 3.5 | 5 ± 0.3 |

[a]Relative percentage of inhibition. Inhibition was compared to that of the control (ascorbic acid, (+)-α-tocopherol and mitoxantrone-HCl); $P < 0.01$, mean ± S.E., $n = 4$. Values are mean percent inhibition at the indicated concentration (mM) with standard errors.

Table 3. Cytotoxicity against the growth of suspended murine and human tumors and inhibitory effect of anthraquinone derivatives (IIIa-n) on iron-induced lipid peroxidation in rat brain homogenates.

| Compd | R | $IC_{50}$ (μM)[a] | | Inhibition of LP (10 mM)[b] |
|---|---|---|---|---|
| | | Hep G2 [c] | C6 cells [d] | |
| IIIa | $CH_2CH_3$ | 4.1 ± 0.5 | 21.1 ± 1.6 | -100 |
| IIIb | $CH_2CH_2CH_3$ | 0.02 ± 0.01 | 38.5 ± 2.8 | 54 ± 2.2 |
| IIIc | $CH_2CH_2CH_2CH_2CH_3$ | 36.2 ± 2.5 | 39.1 ± 4.1 | -55 ± 1.5 |
| IIId | $C(CH_3)_3$ | 13.7 ± 1.8 | 12.0 ± 1.5 | -23 ± 1.1 |
| IIIe | $C_6H_5$ | 47.7 ± 5.5 | 38.7 ± 3.6 | -50 ± 1.9 |
| IIIf | 2-$ClC_6H_4$ | 0.04 ± 0.01 | 40.7 ± 4.7 | 5 ± 0.5 |
| IIIg | 3-$ClC_6H_4$ | 15.1 ± 1.9 | 25.1 ± 2.8 | 1 ± 0.1 |
| IIIh | 4-$ClC_6H_4$ | 48.1 ± 4.5 | 38.6 ± 3.5 | 2 ± 0.2 |
| IIIi | 2,4-$Cl_2C_6H_3$ | >50 | 38.4 ± 4.4 | -1 ± 0.1 |
| IIIj | 2-$CH_3C_6H_4$ | 21.6 ± 2.2 | 25.1 ± 2.8 | 23 ± 1.1 |
| IIIk | 3-$CH_3C_6H_4$ | 18.1 ± 1.5 | 30.1 ± 3.3 | -32 ± 1.5 |
| IIIl | 4-$CH_3C_6H_4$ | 9.3 ± 0.9 | 37.6 ± 4.1 | 33 ± 1.2 |
| IIIm | $CH_2C_6H_5$ | 9.0 ± 1.5 | 39.1 ± 6.2 | -1 ± 0.2 |
| IIIn | $CH_2CH_2C_6H_5$ | 0.4 ± 0.1 | 40.1 ± 5.5 | >100 |
| | mitoxantrone | 2.0 ± 0.5 | 0.07 ± 0.01 | >100 |
| | ascorbic acid | | | >100 |
| | (+)–α-tocopherol | | | >100 |
| | anthrarufin | | | -36 ± 1.1 |

[a] $IC_{50}$, drug concentration inhibiting 50% of cellular growth following 48 h of drug exposure. Values are in μM and represent an average of three experiments. The variance for the $IC_{50}$ was less than ±20%. Inhibition of cell growth was significantly different with respect to that of the control; N = 3 or more, $P < 0.01$. [b] Relative percentage of inhibition. Inhibition was compared to that of the control [ascorbic acid, α-tocopherol and mitoxantrone-HCl], $P < 0.01$, Mean ± S.E., n = 4. Values are mean percent inhibition at the indicated concentration (mM), and standard errors.

[c] Hep G2: human hepatoma G2 cells. [d] C6 cells: rat glioma C6 cells.

Table 4. Inhibitory effects of IIIn on iron-induced lipid peroxidation in rat brain homogenates.

| | Inhibition (%)[a] | | | |
|---|---|---|---|---|
| Compound | 10mM | 1 mM | 0.1 mM | 0.01 mM |
| IIIn | >100 | >100 | 95 ± 2.0 | 50 ± 0.8 |
| ascorbic acid | 100 | 75 ± 1.5 | 32 ± 1.2 | 10 ± 0.6 |
| (+)–α-tocopherol | 100 | 55 ± 1.7 | 0 | 0 |
| mitoxantrone-HCl | 100 | 54 ± 2.1 | 22 ± 3.5 | 5 ± 0.3 |

[a]Relative percentage of inhibition. Inhibition was compared to that of the control ascorbic acid, (+)–α-tocopherol and mitoxantrone-HCl], $P < 0.01$, Mean ± S.E., $n = 4$. Values are mean percent inhibition at the indicated concentration (mM), and standard errors.

Table 5. In vitro Cytotoxicity of Diaminoanthraquinones (IVa-s) Against the Growth of Suspended Murine and Human Tumor Cell Lines

| Compound | R | $IC_{50}$ (μM)[a] | | |
|---|---|---|---|---|
| | | Hep G2[b] | C6 cells[c] | 2.2.15[d] |
| IVa | $CH_2CH_3$ | >20 | >20 | >20 |
| IVb | $CH_2CH_2OH$ | >20 | >20 | 19.26±2.2 |
| IVc | $CH(CH_3)_2$ | 7.64±2.38 | >20 | 18.98±2.4 |
| IVd | $CH_2CH_2N(CH_3)_2$ | 0.09±0.01 | 0.12±0.01 | 0.13±0.01 |
| IVe | $CH_2CH_2NH(CH_2)_2OH$ | 1.20±0.02 | 1.17±0.03 | 8.35±0.11 |
| IVf | $CH_2CH_2CH_3$ | 1.74±0.14 | 16.03±0.68 | 1.94±0.02 |
| IVg | $CH_2CH(CH_3)_2$ | 14.27±1.54 | 12.67±0.37 | >20 |
| IVh | $CH_2CH_2CH_2OH$ | >20 | >20 | >20 |
| IVi | $CH_2CH_2CH_2NH_2$ | 11.67±0.09 | 12.18±0.04 | 7.48±0.09 |
| IVj | $CH_2CH_2CH_2CH_3$ | >20 | >20 | >20 |
| IVk | $CH_2CH_2CH_2CH_2OH$ | >20 | >20 | 10.30±0.24 |
| IVl | $CH_2CH_2CH_2CH_2NH_2$ | 11.61±0.02 | 12.56±0.16 | 10.07±0.58 |
| IVm | $CH_2CH_2CH_2CH_2CH_2NH_2$ | 17.37±0.74 | 8.36±0.13 | >20 |
| IVn | $CH_2CH_2CH_2CH_2CH_2CH_3$ | >20 | >20 | >20 |
| IVo | cyclopentane | >20 | >20 | >20 |
| IVp | 2,3-$(CH_3)_2$-cyclohexane | >20 | >20 | >20 |
| IVq | 4-$OHC_6H_4$ | 4.20±0.76 | 14.21±0.08 | >20 |
| IVr | $CH_2C_6H_5$ | >20 | >20 | >20 |
| IVs | $CH_2CH_2C_6H_5$ | >20 | >20 | >20 |
| | Mitoxantrone | 2.00±0.5 | 0.07±0.01 | 0.40±0.02 |
| | Adriamycin | 0.90±0.01 | 1.00±0.16 | 1.60±0.04 |
| | Cisplatin | 1.48±0.62 | >1 | 2.0±0.54 |

[a]$IC_{50}$, drug concentration inhibiting 50% of cellular growth following 48 h of drug exposure. Values are in μM and represent an average of three experiments. The variance for the $IC_{50}$ values was less than ±20%. Inhibition of cell growth was significantly different with respect to that of the control; $n = 3$ or more, $P < 0.01$. Inhibition was compared with that of control (mitoxantrone-HCl, adriamycin, cisplatin), (μM), and standard errors. [b]Hep G2, human hepatoma G2 cells. [c]C6 cells, rat glioma C6 cells. [d]2.2.15 cells, hepatitis B virus transfected hepatoma cell lines, HepG 2.2.15 cells.

Table 6. Effects of Symmetrical 1,5-Diaminoanthraquinones (IVa-p) on Activating hTERT Expression

| No. | R | Conc. ($\mu$M)[a] | $P_{hTERT}$-SEAP (hTERT-BJ1)[b] Relative MTT viability (%) | Relative SEAP activity (%) | SEAP/vibility |
|---|---|---|---|---|---|
| IVa | $CH_2CH_3$ | 3.3 | 100±4.8 | 94±17.4 | 0.94 |
| | | 33 | 97±1.0 | 96±8.5 | 1.00 |
| | | 339 | 99±3.2 | 66±11.8 | 0.67 |
| IVb | $CH_2CH_2OH$ | 3.0 | 116±5.6 | 45±20.6 | 0.39 |
| | | 30 | 90±26.9 | 16±13.1 | 0.18 |
| | | 308 | 69±18.7 | 11±11.6 | 0.16 |
| IVc | $CH(CH_3)_2$ | 3.1 | 101±4.5 | 32±18.3 | 0.32 |
| | | 31 | 93±6.5 | 23±20.5 | 0.25 |
| | | 310 | 98±12.9 | (-2)±15.3 | -0.02 |
| IVd | $CH_2CH_2N(CH_3)_2$ | 2.6 | 92±4.8 | 11±22.4 | 0.12 |
| | | 26 | 76±5.9 | (-15)±18.2 | -0.19 |
| | | 262 | 7±18.2 | (-26)±16.9 | -3.77 |
| IVe | $CH_2CH_2NH(CH_2)_2OH$ | 2.4 | 84±19.8 | 60±11.6 | 0.72 |
| | | 24 | 60±11.2 | 40±17.3 | 0.67 |
| | | 242 | 44±12.9 | 52±19.1 | 1.18 |
| IVf | $CH_2CH_2CH_3$ | 3.1 | 97±5.6 | 18±16.7 | 0.18 |
| | | 31 | 93±8.9 | 19±24.6 | 0.20 |
| | | 310 | 42±8.1 | (-7)±27.1 | -0.16 |
| IVg | $CH_2CH(CH_3)_2$ | 2.8 | 110±7.6 | 22±18.3 | 0.20 |
| | | 28 | 103±3.0 | 22±21.4 | 0.21 |
| | | 285 | 72±3.3 | 29±3.9 | 0.41 |
| IVh | $CH_2CH_2CH_2OH$ | 2.8 | 72±7.4 | 41±12.5 | 0.57 |
| | | 28 | 39±10.5 | 0±22.1 | 0.01 |
| | | 282 | 26±15.9 | (-3)±10.0 | -0.10 |
| IVi | $CH_2CH_2CH_2NH_2$ | 2.8 | 85±6.9 | 103±19.8 | 1.22 |
| | | 28 | 3±6.9 | 47±20.5 | 15.35 |
| | | 283 | (-2)±7.7 | 60±15.1 | -28.94 |

| | | | | | |
|---|---|---|---|---|---|
| IVj | $CH_2CH_2CH_2CH_3$ | 2.8 | 109±9.1 | 98±27.4 | 0.89 |
| | | 28 | 99±5.9 | 103±27.0 | 1.04 |
| | | 285 | 75±5.9 | 123±22.9 | 1.64 |
| IVk | $CH_2CH_2CH_2CH_2NH_2$ | 2.6 | 101±10.5 | 114±20.5 | 1.13 |
| | | 26 | 101±8.8 | 113±21.6 | 1.12 |
| | | 265 | 91±11.8 | 127±19.9 | 1.39 |
| IVl | $CH_2CH_2CH_2CH_2CH_2CH_3$ | 2.4 | 106±3.9 | 90±19.5 | 0.85 |
| | | 24 | 97±4.6 | 97±17.9 | 1.00 |
| | | 245 | 68±8.5 | 122±30.2 | 1.79 |
| IVm | cyclopentane | 2.6 | 104±3.6 | 18±20.1 | 0.18 |
| | | 26 | 102±4.0 | 14±29.6 | 0.14 |
| | | 267 | 87±4.6 | 34±16.5 | 0.39 |
| IVn | 2,3-$(CH_3)_2$-cyclohexane | 2.1 | 118±10.6 | 94±20.2 | 0.80 |
| | | 21 | 99±8.2 | 92±17.4 | 0.93 |
| | | 218 | 84±6.9 | 90±22.7 | 1.07 |
| IVo | $CH_2C_6H_5$ | 2.3 | 110±4.1 | 110±14.8 | 1.00 |
| | | 23 | 102±5.3 | 92±13.8 | 0.91 |
| | | 238 | 74±4.9 | 86±13.8 | 1.15 |
| IVp | $CH_2CH_2C_6H_5$ | 2.2 | 97±4.0 | 115±12.9 | 1.18 |
| | | 22 | 92±1.0 | 103±12.3 | 1.12 |
| | | 223 | 81±4.7 | 133±23.8 | 1.65 |
| | Mitoxnatrone | 1.9 | 75±2.9 | 30±5.8 | 0.40 |
| | | 19 | 56±3.1 | 13±9.2 | 0.24 |
| | | 193 | 10±2.0 | 4±14.2 | 0.38 |

[a]Values are in μM and represent an average of three experiments. The variance for the relative viability (%) and relative SEAP activity (%) values was less than ± 20%. Activity of $P_{hTERT}$-SEAP (hTERT-BJ1) cell growth was significantly different from that of the control; $n = 3$ or more, $P < 0.05$. Relative percentage of inhibition was not compared with that of the control, $P < 0.01$, mean ± S.E., $n = 4$. Values are mean percent activity at the indicated concentration, and standard errors. [b]The hTERT immortalized hTERT-BJ1 was purchased from BD Biosciences Clontech.

Note: The results in this column are shown as means ± SE of experiments repeated five times. The different symbols qualify as in any concentration of treatment: Relative Cell Viability > 80%, Relative SEAP activity > 100% and P value below 0.05 analyzed with Two-tail T-test.

The ratio of relative cell viability under relative SEAP activity is over 1.2. All of SEAP data are shown as the result that drug-self interference has been subtracted

Table 7. Effects of Symmetrical 1,5-Diaminoanthraquinones (IVa-p) on Repressing hTERT Expression

| No. | R | Conc ($\mu$M)[a] | $P_{hTERT}$-SEAP (hTERT-H1299)[b] Relative MTT viability (%) | Relative SEAP activity (%) | SEAP/vibility |
|---|---|---|---|---|---|
| IVa | $CH_2CH_3$ | 3.3 | 106±7.4 | 108±6.3 | 1.01 |
| | | 33 | 104±3.7 | 101±6.8 | 0.97 |
| | | 339 | 103±6.4 | 95±11.0 | 0.91 |
| IVb | $CH_2CH_2OH$ | 3.0 | 105±6.3 | 91±3.9 | 0.86 |
| | | 30 | 88±9.1 | 88±4.5 | 1.00 |
| | | 308 | 53±2.8 | 5.7±1.1 | 1.08 |
| IVc | $CH(CH_3)_2$ | 3.1 | 114±7.6 | 94±4.1 | 0.82 |
| | | 31 | 111±4.7 | 93±2.0 | 0.84 |
| | | 310 | 50±7.5 | 66±4.7 | 1.32 |
| IVd | $CH_2CH_2N(CH_3)_2$ | 2.6 | 107±9.1 | 103±6.0 | 0.95 |
| | | 26 | 81±8.3 | 54±5.9 | 0.67 |
| | | 262 | 29±2.6 | 40±5.9 | 1.39 |
| IVe | $CH_2CH_2NH(CH_2)_2OH$ | 2.4 | 97±8.7 | 87±3.8 | 0.89 |
| | | 24 | 37±3.9 | 43±5.5 | 1.15 |
| | | 242 | 11±4.1 | 40±6.7 | 3.77 |
| IVf | $CH_2CH_2CH_3$ | 3.1 | 99±7.6 | 101±15.3 | 1.02 |
| | | 31 | 98±5.8 | 100±5.6 | 1.03 |
| | | 310 | 46±9.5 | 89±8.3 | 1.93 |
| IVg | $CH_2CH(CH_3)_2$ | 2.8 | 108±4.8 | 94±7.0 | 0.87 |
| | | 28 | 106±3.7 | 91±2.5 | 0.85 |
| | | 285 | 80±4.8 | 75±4.1 | 0.94 |
| IVh | $CH_2CH_2CH_2OH$ | 2.8 | 107±5.0 | 88±4.9 | 0.82 |
| | | 28 | 49±3.5 | 69±5.4 | 1.41 |
| | | 282 | 40±10.4 | 33±2.2 | 0.81 |
| IVi | $CH_2CH_2CH_2NH_2$ | 2.8 | 85±11.5 | 102±4.9 | 1.20 |
| | | 28 | 32±9.3 | 44±7.5 | 1.39 |
| | | 283 | 16±2.1 | 38±6.0 | 2.34 |

| | | | | |
|---|---|---|---|---|
| IVj $CH_2CH_2CH_2CH_3$ | 2.8 | 102±7.0 | 106±7.1 | 1.04 |
| | 28 | 104±9.2 | 105±5.5 | 1.01 |
| | 285 | 81±13.9 | 98±5.2 | 1.21 |
| IVk $CH_2CH_2CH_2CH_2NH_2$ | 2.6 | 114±8.1 | 89±4.9 | 0.78 |
| | 26 | 110±7.1 | 71±9.8 | 0.65 |
| | 265 | 16±3.4 | 27±2.0 | 1.65 |
| IVl $CH_2CH_2CH_2CH_2CH_2CH_3$ | 2.4 | 99±5.3 | 101±6.1 | 1.02 |
| | 24 | 95±6.2 | 106±9.1 | 1.11 |
| | 245 | 85±8.8 | 104±9.4 | 1.22 |
| IVm cyclopentane | 2.6 | 114±7.5 | 98±4.5 | 0.86 |
| | 26 | 110±5.7 | 95±2.8 | 0.86 |
| | 267 | 86±8.2 | 90±4.8 | 1.05 |
| IVn 2,3-$(CH_3)_2$-cyclohexane | 2.1 | 88±7.9 | 103±9.2 | 1.17 |
| | 21 | 84±10.2 | 105±5.1 | 1.25 |
| | 218 | 58±8.0 | 96±4.5 | 1.64 |
| IVo $CH_2C_6H_5$ | 2.3 | 98±8.4 | 99±5.0 | 1.01 |
| | 23 | 100±7.3 | 103±8.9 | 1.04 |
| | 238 | 40±8.4 | 97±3.8 | 2.45 |
| IVp $CH_2CH_2C_6H_5$ | 2.2 | 94±5.2 | 105±3.0 | 1.12 |
| | 22 | 97±3.2 | 103±9.5 | 1.06 |
| | 223 | 77±4.2 | 96±2.9 | 1.25 |
| Mitoxnatrone | 1.9 | 100±5.6 | 81±3.8 | 0.82 |
| | 19 | 57±4.3 | 66±4.0 | 1.16 |
| | 193 | 39±3.2 | 47±3.9 | 1.21 |

[a]Values are in μM and represent an average of three experiments. The variance for the relative viability (%) and relative SEAP activity (%) values was less than ± 20%. Repression of $P_{hTERT}$-SEAP (hTERT-H1299) cell growth was significantly different from that of the control; $n = 3$ or more, $P < 0.05$. Relative percentage of inhibition was not compared with that of the control, $P < 0.01$, mean ± S.E., $n = 4$. Values are mean percent activity at the indicated concentration, and standard errors. [b]The hTERT cancer cell hTERT-H1299 was purchased from BD Biosciences Clontech.

Table 8. In vitro Cytotoxicity of 1,8-Diaminoanthraquinones (Va-p) Against the Growth of Suspended Murine and Human Tumor Cell Lines

| Compound | R | $IC_{50}$ (μM)[a] | | |
|---|---|---|---|---|
| | | C6 cells[c] | Hep G2[b] | 2.2.15[d] |
| Va | $CH_2CH_3$ | >20 | >20 | >20 |
| Vb | $CH_2CH_2CH_3$ | 0.61±0.01 | 0.19±0.01 | 1.06±0.03 |
| Vc | $CH_2CH_2CH_2CH_3$ | >20 | >20 | >20 |
| Vd | $CH_2CH(CH_3)_2$ | 1.32±0.01 | >20 | >20 |
| Ve | $(CH_2)_5CH_3$ | >20 | >20 | >20 |
| Vf | $CH(CH_3)_2$ | 1.24±0.01 | >20 | >20 |
| Vg | $CH_2CH_2OH$ | 0.02±0.01 | >20 | >20 |
| Vh | $CH_2CH_2CH_2OH$ | 1.00±0.01 | >20 | >20 |
| Vi | $CH_2CH_2CH_2CH_2OH$ | 0.41±0.02 | 1.65±0.13 | >20 |
| Vj | $CH_2CH_2N(CH_3)_2$ | 0.15±0.04 | 0.16±0.04 | 8.55±0.09 |
| Vk | $CH_2CH_2CH_2NH_2$ | >20 | 11.43±0.17 | >20 |
| Vl | $CH_2CH_2CH_2CH_2NH_2$ | >20 | 11.47±0.34 | >20 |
| Vm | $CH_2CH_2CH_2CH_2CH_2NH_2$ | 0.11±0.01 | 0.09±0.01 | 1.29±0.06 |
| Vn | Cyclopentane | >20 | >20 | >20 |
| Vo | $CH_2C_6H_5$ | 1.66±0.09 | >20 | >20 |
| Vp | $CH_2CH_2C_6H_5$ | >20 | >20 | >20 |
| | Mitoxantrone | 0.07±0.01 | 2.0±0.50 | 0.40±0.02 |
| | Adriamycin | 1.00±0.16 | 0.90±0.01 | 1.60±0.04 |

[a]$IC_{50}$, drug concentration inhibiting 50% of cellular growth following 48 h of drug exposure. Values are in μM and represent an average of three experiments. The variance for the $IC_{50}$ values was less than ±20%. Inhibition of cell growth was significantly different with respect to that of the control; $n = 3$ or more, $P < 0.01$. Inhibition was compared with that of the control (mitoxantrone-HCl, adriamycin, cisplatin), (μM), and standard errors. [b]Hep G2, human hepatoma G2 cells. [c]C6 cells, rat glioma C6 cells. [d]2.2.15 cells, hepatitis B virus transfected hepatoma cell lines, HepG 2.2.15 cells.

Table 9. In vitro Cytotoxicity of 1,4-Diamidoanthraquinones ($VI_{1-37}$) Against the Growth of Suspended Murine and Human Tumor Cell Lines

| Compound | R | $IC_{50}$ (μM)[a] | | |
|---|---|---|---|---|
| | | C6 cells[c] | Hep G2[b] | 2.2.15[d] |
| $VI_1$ | $CH_2Cl$ | >20 | >20 | >20 |
| $VI_2$ | 2-$ClC_6H_4$ | >20 | >20 | >20 |
| $VI_3$ | $CH_3$ | >20 | >20 | >20 |
| $VI_4$ | $C_6H_5$ | >20 | >20 | >20 |
| $VI_5$ | 3-$ClC_6H_4$ | >20 | >20 | >20 |
| $VI_6$ | 3-$CH_3C_6H_4$ | >20 | >20 | >20 |
| $VI_7$ | $CH_2CH_2Cl$ | >20 | >20 | >20 |
| $VI_8$ | 2,4-$Cl_2C_6H_3$ | >20 | >20 | >20 |
| $VI_9$ | $CHClCH_3$ | >20 | >20 | >20 |
| $VI_{10}$ | 2-$FC_6H_4$ | >20 | >20 | >20 |
| $VI_{11}$ | 2-$NO_2C_6H_4$ | >20 | >20 | >20 |
| $VI_{12}$ | 3-$FC_6H_4$ | >20 | >20 | >20 |
| $VI_{13}$ | 2,4,6-$Cl_3C_6H_2$ | >20 | 2.77±0.93 | 3.63±2.33 |
| $VI_{14}$ | 2,3,6-$F_3C_6H_2$ | >20 | >20 | >20 |
| $VI_{15}$ | 2,4,5-$Cl_3C_6H_2$ | >20 | >20 | 3.35±3.24 |
| $VI_{16}$ | 4-$ClC_6H_4$ | >20 | >20 | >20 |
| $VI_{17}$ | cyclohexane | >20 | >20 | >20 |
| $VI_{18}$ | 2,4-$F_2C_6H_3$ | >20 | >20 | >20 |
| $VI_{19}$ | $(CH_2)_2CH(CH_2)_4$ | >20 | >20 | >20 |
| $VI_{20}$ | cyclopentane | >20 | >20 | >20 |
| $VI_{21}$ | cyclopropane | >20 | >20 | >20 |
| $VI_{22}$ | 2-$SC(CH)_3$ | >20 | >20 | >20 |
| $VI_{23}$ | 2,3-$Cl_2$-5-$FC_6H_2$ | >20 | >20 | >20 |
| $VI_{24}$ | 2-$OC(CH)_3$ | >20 | >20 | >20 |
| $VI_{25}$ | $CH_2$-2-S-$C(CH)_3$ | >20 | >20 | 15.47±12.00 |
| $VI_{26}$ | 3-O-2,5-$(CH_3)_2CH$ | >20 | >20 | >20 |
| $VI_{27}$ | $CH(CH_2)CHC_6H_5$ | >20 | >20 | 19.48±18.13 |
| $VI_{28}$ | $CH_2SC_6H_5$ | >20 | >20 | >20 |

| | | | | |
|---|---|---|---|---|
| $VI_{29}$ | $C_6H_3(CF_3)_2(o,m)$ | 2.82±0.47 | >20 | 2.20±0.64 |
| $VI_{30}$ | $C_6H_4F(p)$ | >20 | >20 | >20 |
| $VI_{31}$ | $C_6H_4CF_3(p)$ | >20 | >20 | >20 |
| $VI_{32}$ | $CH_2C_6H_4F(p)$ | >20 | >20 | >20 |
| $VI_{33}$ | $CH_2N(CH_2CH_3)_2$ | 4.46±2.76 | 0.65±0.62 | 12.97±11.93 |
| $VI_{34}$ | $(CH_2)_2N(CH_2CH_3)_2$ | 0.90±0.68 | 0.49±0.41 | 0.28±0.01 |
| $VI_{35}$ | $CHCH_3N(CH_2CH_3)_2$ | 18.09±14.11 | 2.02±0.26 | 8.57±7.18 |
| $VI_{36}$ | $CHCH_3NHCH_2CH(CH_2)_2$ | 2.76±1.74 | 6.46±1.40 | 3.46±1.15 |
| $VI_{37}$ | $CH_2CH_2NHCH_2CH(CH_2)_2$ | 0.40±0.09 | 0.32±0.29 | 1.71±1.67 |
| | Mitoxantrone | 0.07±0.01 | 2.0±0.50 | 0.40±0.02 |
| | Adriamycin | 1.00±0.16 | 0.90±0.01 | 1.60±0.04 |

[a]$IC_{50}$, drug concentration inhibiting 50% of cellular growth following 48 h of drug exposure. Values are in μM and represent an average of three experiments. The variance for the $IC_{50}$ values was less than ±20%. Inhibition of cell growth was significantly different with respect to that of the control; $n = 3$ or more, $P < 0.01$. Inhibition was compared with that of the control (mitoxantrone-HCl, adriamycin, cisplatin), (μM), and standard errors. [b]Hep G2, human hepatoma G2 cells. [c]C6 cells, rat glioma C6 cells. [d]2.2.15 cells, hepatitis B virus transfected hepatoma cell lines, HepG 2.2.15 cells.

Table 10. Effects of Symmetrical 1,5-*bis*-thio-Substituted Anthraquinones (IIa-o) on Respressing and Activating hTERT Expression

| No. | R | Conc. (μM)[a] | $P_{hTERT}$-SEAP (H1299)[b] Relative viability (%) | $P_{hTERT}$-SEAP (H1299)[b] Relative SEAP activity (%) | $P_{hTERT}$-SEAP (hTERT-BJ1)[c] Relative viability (%) | $P_{hTERT}$-SEAP (hTERT-BJ1)[c] Relative SEAP activity (%) |
|---|---|---|---|---|---|---|
| IIa | $CH_2CH_3$ | 3.0 | 111±2.8 | 134±14.4 | 112±9.2 | 109±22.4 |
| | | 30 | 44±7.3 | 111±7.7 | 98±12.3 | 110±14.3 |
| | | 300 | 25±2.3 | 99±14.3 | 34±18.1 | 104±20.6 |
| IIb | $CH_2CH_2OH$ | 2.8 | 54±4.0 | 97±15.7 | 94±9.3 | 104±15.7 |
| | | 28 | 29±7.0 | 76±12.4 | 49±2.9 | 98±10.9 |
| | | 280 | 36±7.2 | 45±2.7 | 23±2.9 | 71±5.0 |
| IIc | $CH_2CH_2CH_3$ | 2.8 | 96±5.9 | 73±5.4 | 103±6.3 | 132±21.0 |
| | | 28 | 44±2.5 | 29±2.5 | 97±3.0 | 110±13.2 |
| | | 280 | 25±2.4 | 17±13.9 | 39±4.9 | 122±14.3 |
| IId | $CH_2CH(OH)CH_2OH$ | 2.4 | 102±6.2 | 105±21.6 | 98±10.7 | 144±16.9 |
| | | 24 | 103±4.2 | 90±5.7 | 86±5.5 | 136±10.0 |
| | | 240 | 83±18.2 | 81±6.1 | 79±8.2 | 142±9.1 |
| IIe | $(CH_2)_6OH$ | 2.1 | 99±6.2 | 110±6.1 | 99±6.2 | 140±9.7 |
| | | 21 | 94±3.9 | 100±5.5 | 70±2.2 | 128±14.4 |
| | | 210 | 36±4.2 | 68±5.9 | 40±4.7 | 75±17.4 |
| IIf | $2\text{-}NH_2C_6H_4$ | 2.2 | 94±3.5 | 108±12.2 | 103±7.9 | 136±17.5 |
| | | 22 | 50±3.3 | 96±8.4 | 107±5.5 | 141±18.2 |
| | | 220 | 14±2.5 | 59±6.6 | 25±3.3 | 115±29.7 |
| IIg | $3\text{-}NH_2C_6H_4$ | 2.2 | 92±3.5 | 106±7.6 | 104±5.1 | 118±9.9 |
| | | 22 | 68±1.9 | 109±11.7 | 9±3.4 | 41±9.5 |
| | | 220 | 32±4.9 | 101±7.3 | 4±1.5 | 8±30.6 |
| IIh | $4\text{-}NH_2C_6H_4$ | 2.2 | 103±4.3 | 100±5.7 | 86±11.9 | 97±17.9 |
| | | 22 | 76±4.0 | 95±2.6 | 65±12.6 | 97±14.5 |
| | | 220 | 42±2.3 | 84±5.3 | 56±13.8 | 26±12.6 |
| IIi | $CH_2C_6H_5$ | 2.2 | 83±5.5 | 97±6.0 | 121±4.7 | 117±11.3 |
| | | 22 | 44±0.9 | 100±7.2 | 98±4.2 | 112±9.3 |
| | | 220 | 34±3.3 | 100±12.9 | 47±9.1 | 87±11.1 |

| | | | | | | |
|---|---|---|---|---|---|---|
| IIj | $CH_2C_6H_4(OCH_3)(p)$ | 2.2 | 89±6.1 | 92±3.3 | 119±9.4 | 142±27.7 |
| | | 22 | 59±5.4 | 96±8.5 | 98±13.4 | 141±22.6 |
| | | 220 | 42±.3 | 88±5.6 | 62±6.4 | 118±19.2 |
| IIk | $CH_2CH_2C_6H_5$ | 2.2 | 93±6.2 | 108±0.5 | 91±3.9 | 119±12.2 |
| | | 22 | 51±9.3 | 102±0.5 | 54±4.4 | 109±23.4 |
| | | 220 | 27±2.9 | 97±4.8 | 35±4.1 | 110±30.6 |
| IIL | $C_4H_3N_2$ | 2.3 | 107±5.1 | 105±6.6 | 104±8.9 | 137±12.3 |
| | | 23 | 99±5.8 | 110±8.0 | 103±6.4 | 125±6.9 |
| | | 230 | 44±6.3 | 49±10.0 | 73±8.3 | 61±8.7 |
| IIm | $C_5H_4N$ | 2.3 | 79±12.2 | 104±12.6 | 112±6.4 | 98±12.3 |
| | | 23 | 45±7.1 | 103±15.8 | 91±7.3 | 133±6.8 |
| | | 230 | 29±1.5 | 89±9.3 | 55±11.3 | 121±13.8 |
| IIn | $C_4H_2N_2(OH)(m)$ | 2.2 | 99±4.0 | 92±7.1 | 104±7.6 | 93±7.9 |
| | | 22 | 95±4.9 | 97±2.9 | 106±6.3 | 116±15.4 |
| | | 220 | 51±16.7 | 93±12.1 | 89±3.5 | 145±20.7 |
| IIo | $C_6H_4CH_3$ | 2.2 | 84±5.9 | 117±12.5 | 111±5.4 | 132±19.3 |
| | | 22 | 41±2.4 | 103±10.5 | 77±6.9 | 109±5.7 |
| | | 220 | 25±2.4 | 90±11.6 | 22±8.5 | 87±29.6 |

[a]Values are in μM and represent an average of three experiments. The variance for the relative viability (%) and relative SEAP activity (%) values was less than ± 20%. Activity of $P_{hTERT}$-SEAP (H1299) and (hTERT-BJ1) cell growth was significantly different with respect to that of the control; $n = 3$ or more, $P < 0.01$. Relative percentage of inhibition was not compared with that of the control, $P < 0.01$, mean ± S.E., $n = 4$. Values are the mean percent activity at the indicated concentration, and include standard errors. [b]Non-small-cell lung cancer cells H1299. [c]The hTERT immortalized hTERT-BJ1 was purchased from BD Biosciences Clontech.

Table 11. Effects of Symmetrical 1,5-Bisacyloxyanthraquinones (IIIa-n) on Respressing and Activating hTERT Expression

| No. | R | Conc. μM[a] | $P_{hTERT}$-SEAP (H1299)[b] Relative viability (%) | $P_{hTERT}$-SEAP (H1299)[b] Relative SEAP activity (%) | $P_{hTERT}$-SEAP (hTERT-BJ1)[c] Relative viability (%) | $P_{hTERT}$-SEAP (hTERT-BJ1)[c] Relative SEAP activity (%) |
|---|---|---|---|---|---|---|
| IIIa | $COCH_2CH_3$ | 2.8 | 116±8.0 | 103±5.8 | 99±11.9 | 131±7.0 |
| | | 28 | 116±7.4 | 107±4.9 | 109±8.7 | 152±16.7 |
| | | 280 | 87±6.6 | 97±3.1 | 93±10.8 | 161±12.2 |
| IIIb | $COCH_2CH_2CH_3$ | 2.6 | 107±5.6 | 114±7.9 | 109±5.1 | 107±11.9 |
| | | 26 | 106±3.2 | 118±8.4 | 106±5.6 | 119±8.3 |
| | | 260 | 87±6.5 | 111±4.4 | 85±6.6 | 134±3.8 |
| IIIc | $CO(CH_2)_4CH_3$ | 2.3 | 117±5.1 | 91±9.9 | 119±9.4 | 147±18.8 |
| | | 23 | 114±4.7 | 95±17.4 | 98±13.4 | 149±16.1 |
| | | 230 | 106±4.3 | 95±10.5 | 62±6.4 | 124±5.3 |
| IIId | $COC(CH_3)_3$ | 2.4 | 106±8.9 | 105±4.9 | 94±3.4 | 147±11.1 |
| | | 24 | 97±7.1 | 78±14.8 | 93±6.0 | 165±18.7 |
| | | 240 | 70±5.2 | 80±10.1 | 100±9.0 | 141±14.4 |
| IIIe | $COC_6H_5$ | 2.2 | 99±7.3 | 88±10.0 | 103±6.5 | 137±10.0 |
| | | 22 | 60±11.9 | 94±8.0 | 87±9.8 | 122±9.6 |
| | | 220 | 33±4.7 | 86±4.7 | 51±4.6 | 84±21.7 |
| IIIf | $COC_6H_4Cl(o)$ | 1.9 | 74±5.3 | 93±4.4 | 107±5.5 | 120±10.5 |
| | | 19 | 34±3.4 | 101±4.9 | 92±4.3 | 116±3.7 |
| | | 190 | 30±1.4 | 97±5.3 | 40±4.0 | 97±10.8 |
| IIIg | $COC_6H_4Cl(m)$ | 1.9 | 98±3.9 | 83±5.7 | 101±2.3 | 154±23.0 |
| | | 19 | 88±7.2 | 92±8.1 | 80±6.7 | 152±15.8 |
| | | 190 | 46±3.5 | 81±2.5 | 44±6.0 | 91±25.2 |
| IIIh | $COC_6H_4Cl(p)$ | 1.9 | 91±10.0 | 106±4.5 | 111±6.5 | 136±5.7 |
| | | 19 | 57±1.8 | 106±4.9 | 89±14.3 | 123±6.2 |
| | | 190 | 31±1.0 | 97±4.9 | 48±9.0 | 107±6.0 |
| IIIi | $COC_6H_4Cl_2(o,p)$ | 1.8 | 108±3.8 | 100±5.2 | 107±7.2 | 155±16.3 |
| | | 18 | 103±5.9 | 102±5.4 | 102±4.1 | 150±13.9 |
| | | 180 | 77±2.8 | 96±4.4 | 96±7.0 | 160±36.7 |

| | | | | | | |
|---|---|---|---|---|---|---|
| IIIj | $COC_6H_4CH_3(o)$ | 2.1 | 72±4.9 | 97±4.4 | 118±11.6 | 129±13.0 |
| | | 21 | 36±9.7 | 91±7.4 | 82±8.5 | 120±24.0 |
| | | 210 | 45±8.0 | 90±4.2 | 39±13.0 | 94±27.1 |
| IIIk | $COC_6H_4CH_3(m)$ | 2.1 | 26±3.7 | 104±5.4 | 98±9.4 | 141±10.5 |
| | | 21 | 28±5.0 | 116±12.8 | 54±7.5 | 124±15.6 |
| | | 210 | 29±3.3 | 110±16.4 | 47±4.8 | 86±17.2 |
| IIIL | $COC_6H_4CH_3(p)$ | 2.1 | 61±5.8 | 98±1.1 | 102±13.9 | 130±8.8 |
| | | 21 | 33±2.8 | 95±4.3 | 98±6.3 | 126±13.3 |
| | | 210 | 32±5.7 | 95±8.9 | 56±6.2 | 99±15.8 |
| IIIm | $COCH_2C_6H_5$ | 2.1 | 91±4.2 | 98±0.3 | 106±9.0 | 129±4.5 |
| | | 21 | 53±2.3 | 101±6.8 | 97±8.2 | 125±4.3 |
| | | 210 | 30±1.6 | 142±14 | 64±10.2 | 100±17.3 |
| IIIn | $COCH_2CH_2C_6H_5$ | 2.0 | 111±0.8 | 94±2.5 | 111±7.3 | 126±6.1 |
| | | 20 | 101±4.3 | 98±4.7 | 106±6.6 | 124±13.4 |
| | | 200 | 54±4.1 | 89±5.2 | 76±7.2 | 110±10.5 |

[a]Values are in μM and represent an average of three experiments. The variance for the relative viability (%) and relative SEAP activity (%) values was less than ± 20%. Activity of $P_{hTERT}$-SEAP (H1299) and (hTERT-BJ1) cell growth was significantly different from that of the control; $n = 3$ or more, $P < 0.01$. Relative percentage of inhibition was not compared with that of the control, $P < 0.01$, mean ± S.E., $n = 4$. Values are the mean percent activity at the indicated concentration, and include standard errors. [b]Non-small-cell lung cancer cells H1299. [c]The hTERT immortalized hTERT-BJ1 was purchased from BD Biosciences Clontech.

Table 12. Effects of Anthraquinones on the CMV Promoter Activity

| Compd. | Concn[a] (μM) | $P_{CMV}$-SEAP (hTERT-BJ1)[b] Relative viability (%) | Relative SEAP activity (%) |
|---|---|---|---|
| IIf | 2.2 | 108±9 | 103±8 |
| | 22 | 109±4 | 102±10 |
| | 220 | 48±6 | 122±8 |
| IIj | 2.0 | 116±13 | 103±15 |
| | 22 | 67±18 | 102±8 |
| | 220 | 52±7 | 100±8 |
| IIn | 2.2 | 107±10 | 112±15 |
| | 22 | 118±9 | 105±16 |
| | 220 | 78±18 | 120±14 |
| IIIa | 2.8 | 114±16 | 101±6 |
| | 28 | 110±12 | 112±6 |
| | 280 | 94±21 | 138±12 |
| IIId | 2.4 | 115±7 | 102±10 |
| | 24 | 104±8 | 114±18 |
| | 240 | 103±11 | 141±11 |
| IIIi | 1.8 | 105±8 | 99±15 |
| | 18 | 105±7 | 111±11 |
| | 180 | 108±15 | 121±17 |

[a]Values are in μM and represent an average of three experiments. The variance for the relative viability (%) and relative SEAP activity (%) values was less than ± 20%. Activity of $P_{CMV}$-SEAP (hTERT-BJ1) cell growth was significantly different from that of the control; $n$ = 3 or more, $P < 0.01$. Relative percentage of inhibition was not compared with that of the control, $P < 0.01$, mean ± S.E., $n = 4$. Values are the mean percent activity at the indicated concentration and include standard errors. [b]CMV (cytomegalovirus); SEAP (secreted alkaline phosphatase).

Table 13. Effects of Symmetrical 1,4-Diamidoanthraquinones ($VI_{1-37}$) on Activating hTERT Expression

| No. | R | Conc. ($\mu$M)[a] | $P_{hTERT}$-SEAP (hTERT-BJ1)[b] Relative MTT viability (%) | Relative SEAP activity (%) | SEAP/vibility |
|---|---|---|---|---|---|
| $VI_1$ | $CH_2Cl$ | 2.5 | 101±2.7 | 123±16.8 | 1.23 |
| | | 25 | 84±6.3 | 129±17.7 | 1.53 |
| | | 255 | 44±4.7 | 121±10.9 | 2.76 |
| $VI_7$ | $(CH_2)_2Cl$ | 2.3 | 102±4.1 | 36±12.1 | 0.36 |
| | | 23 | 82±8.2 | 40±10.8 | 0.48 |
| | | 238 | 60±2.5 | 14±11.8 | 0.23 |
| $VI_9$ | $CH(Cl)CH_3$ | 2.3 | 94±10.4 | 91±10.8 | 0.97 |
| | | 23 | 68±8.2 | 101±8.4 | 1.49 |
| | | 238 | 48±2.3 | 81±8.5 | 1.68 |
| $VI_{33}$ | $CH_2N(CH_2CH_3)_2$ | 2.1 | 105±2.8 | 111±24.4 | 1.06 |
| | | 21 | 86±3.5 | 120±25.6 | 1.40 |
| | | 215 | 32±13.1 | 83±19.0 | 2.61 |
| $VI_{34}$ | $(CH_2)_2N(CH_2CH_3)_2$ | 2.0 | 83±9.2 | 2±11.1 | 0.03 |
| | | 20 | 15±3.9 | (-2)±11.2 | -0.13 |
| | | 203 | 6±3.9 | (-2)±6.5 | -0.37 |
| $VI_{35}$ | $CH(CH_3)N(CH_2CH_2)_2$ | 2.0 | 97±3.9 | 40±14.5 | 0.41 |
| | | 20 | 52±7.2 | 49±9.3 | 0.94 |
| | | 203 | 36±5.8 | 22±6.6 | 0.61 |
| $VI_{36}$ | $CH(CH_2)NCH_2CH(CH_2)_2$ | 2.0 | 103±6.4 | 91±19.4 | 0.88 |
| | | 20 | 92±11.4 | 95±14.2 | 1.03 |
| | | 204 | 104±17.4 | 65±15.7 | 0.63 |
| $VI_{37}$ | $(CH_2)_2NCH_2CH(CH_2)_2$ | 2.0 | 95±2.5 | 97±13.8 | 1.02 |
| | | 20 | 84±1.5 | 124±22.8 | 1.48 |
| | | 204 | 35±3.7 | 105±17.7 | 3.01 |
| $VI_3$ | $CH_3$ | 3.1 | 117±3.0 | 77±12.4 | 0.66 |
| | | 31 | 95±11.9 | 83±10.0 | 0.87 |
| | | 310 | 49±8.9 | 59±15.2 | 1.20 |

| | | | | |
|---|---|---|---|---|
| $VI_{21}$ cyclopropane | 2.6 | 103±6.8 | 64±9.5 | 0.62 |
| | 26 | 82±5.9 | 54±8.8 | 0.66 |
| | 267 | 58±4.1 | 43±8.3 | 0.74 |
| $VI_{20}$ cyclopentane | 2.3 | 106±2.3 | 85±7.7 | 0.81 |
| | 23 | 103±4.4 | 93±18.5 | 0.90 |
| | 233 | 93±5.7 | 63±36.5 | 0.67 |
| $VI_{17}$ cyclohexane | 2.1 | 102±3.0 | 65±16.0 | 0.64 |
| | 21 | 97±2.4 | 42±24.3 | 0.44 |
| | 218 | 83±4.2 | 56±16.3 | 0.68 |
| $VI_{19}$ $(CH_2)_2CH(CH_2)_4$ | 2.0 | 107±3.6 | 90±9.2 | 0.84 |
| | 20 | 101±4.7 | 87±5.5 | 0.87 |
| | 205 | 100±5.8 | 87±8.0 | 0.87 |
| $VI_{22}$ 2-$SC(CH)_3$ | 2.1 | 118±10.6 | 94±20.2 | 0.80 |
| | 21 | 99±8.2 | 92±17.4 | 0.93 |
| | 218 | 84±6.9 | 90±22.7 | 1.07 |
| $VI_{24}$ 2-$OC(CH)_3$ | 2.3 | 91±9.5 | 39±7.8 | 0.43 |
| | 23 | 69±10.7 | 45±11.0 | 0.65 |
| | 234 | 72±11.3 | 37±15.0 | 0.51 |
| $VI_{25}$ $CH_2$-2-$SC(CH)_3$ | 2.0 | 116±7.5 | 53±17.4 | 0.45 |
| | 20 | 105±4.4 | 40±12.7 | 0.38 |
| | 205 | 76±6.5 | 14±24.1 | 0.19 |
| $VI_4$ $C_6H_5$ | 2.2 | 95±4.9 | (-4)±25.7 | -0.04 |
| | 22 | 69±3.2 | (-10)±26.8 | -0.14 |
| | 224 | 38±2.6 | (-41)±26.8 | -1.10 |
| $VI_6$ 3-$CH_3C_6H_4$ | 2.1 | 110±2.6 | 97±17.1 | 0.88 |
| | 21 | 109±4.6 | 78±7.1 | 0.71 |
| | 210 | 101±6.0 | 70±5.8 | 0.69 |
| $VI_{10}$ 2-$FC_6H_4$ | 2.0 | 106±6.5 | 95±8.9 | 0.90 |
| | 20 | 105±8.5 | 96±9.8 | 0.96 |
| | 207 | 86±7.3 | 79±7.4 | 0.92 |
| $VI_{12}$ 3-$FC_6H_4$ | 2.0 | 102±1.5 | 107±11.9 | 1.05 |
| | 20 | 97±2.9 | 108±15.5 | 1.11 |

| | | | | |
|---|---|---|---|---|
| | 207 | 85±2.6 | 95±13.9 | 1.12 |
| $VI_{30}$ 4-$FC_6H_4$ | 2.0 | 103±9.0 | 104±16.3 | 1.01 |
| | 20 | 107±3.1 | 101±27.6 | 0.95 |
| | 207 | 83±5.3 | 100±14.5 | 1.20 |
| $VI_2$ 2-$ClC_6H_4$ | 1.9 | 116±7.7 | 110±20.1 | 0.95 |
| | 19 | 109±2.2 | 96±33.4 | 0.88 |
| | 194 | 95±2.0 | 95±36.6 | 1.00 |
| $VI_5$ 3-$ClC_6H_4$ | 1.9 | 99±9.8 | 98±10.1 | 0.99 |
| | 19 | 90±1.9 | 105±8.8 | 1.17 |
| | 194 | 60±2.0 | 89±10.1 | 1.48 |
| $VI_{16}$ 4-$ClC_6H_4$ | 1.9 | 111±0.8 | 116±28.6 | 1.05 |
| | 19 | 103±5.9 | 112±21.9 | 1.09 |
| | 194 | 99±5.2 | 152±39.7 | 1.54 |
| $VI_{11}$ 2-$NO_2C_6H_4$ | 1.8 | 110±4.1 | 102±33.4 | 0.92 |
| | 18 | 107±6.3 | 122±19.5 | 1.14 |
| | 186 | 99±3.2 | 114±28.1 | 1.15 |
| $VI_{31}$ 2-$CF_3C_6H_4$ | 1.7 | 98±4.4 | 100±15.1 | 1.02 |
| | 17 | 100±3.4 | 90±16.3 | 0.90 |
| | 171 | 89±3.6 | 103±17.6 | 1.16 |
| $VI_{29}$ 2,3-$(CF_3)_2C_6H_3$ | 1.3 | 107±6.4 | 16±31.8 | 0.15 |
| | 13 | 85±4.8 | 24±21.5 | 0.28 |
| | 139 | 56±4.6 | 26±36.9 | 0.47 |
| $VI_{18}$ 2,4-$F_2C_6H_3$ | 1.9 | 104±5.6 | 48±21.7 | 0.46 |
| | 19 | 101±4.4 | 51±18.5 | 0.50 |
| | 192 | 103±6.1 | 48±23.1 | 0.46 |
| $VI_8$ 2,4-$Cl_2C_6H_3$ | 1.7 | 102±3.4 | 33±11.2 | 0.32 |
| | 17 | 98±7.2 | 25±17.2 | 0.26 |
| | 171 | 76±4.8 | 39±12.8 | 0.52 |
| $VI_{13}$ 2,4,6-$Cl_3C_6H_2$ | 1.5 | 98±8.5 | 31±23.0 | 0.32 |
| | 15 | 63±7.0 | 12±12.5 | 0.19 |
| | 153 | 40±22.2 | 4±15 | 0.09 |
| $VI_{14}$ 2,3,6-$F_3C_6H_2$ | 1.8 | 102±3.3 | 35±14.1 | 0.35 |

| | | | | |
|---|---|---|---|---|
| | 18 | 90±6.0 | 22±24.4 | 0.25 |
| | 180 | 70±6.8 | 31±7.9 | 0.44 |
| $VI_{15}$ 2,4,5-$F_3C_6H_2$ | 1.6 | 104±4.5 | 117±14.2 | 1.12 |
| | 16 | 89±5.0 | 114±20.4 | 1.29 |
| | 161 | 80±3.8 | 115±30.8 | 1.44 |
| $VI_{23}$ 2,3-$Cl_2$-5-$FC_6H_2$ | 1.6 | 111±6.8 | 113±16.0 | 1.02 |
| | 16 | 110±7.1 | 131±19.1 | 1.20 |
| | 161 | 101±6.6 | 106±17.3 | 1.05 |
| $VI_{27}$ $CH(CH_2)CHC_6H_5$ | 1.8 | 92±16.9 | 92±16.9 | 0.89 |
| | 18 | 97±18.2 | 97±18.2 | 0.99 |
| | 189 | 104±10.7 | 102±16.6 | 0.98 |
| $VI_{28}$ $CH_2SC_6H_5$ | 1.8 | 115±4.8 | 14±14.7 | 0.12 |
| | 18 | 105±6.7 | 23±9.5 | 0.21 |
| | 185 | 60±2.3 | 7±9.6 | 0.12 |
| $VI_{32}$ $CH_2$-4-$FC_6H_4$ | 1.9 | 107±7.2 | 90±18.4 | 0.84 |
| | 19 | 100±6.3 | 102±20.0 | 1.02 |
| | 195 | 96±4.1 | 97±11.6 | 1.01 |
| $VI_{26}$ 2,5-dimethylfuran | 2.0 | 101±6.2 | 84±13.3 | 0.83 |
| | 20 | 101±5.8 | 79±14.7 | 0.78 |
| | 207 | 93±7.1 | 81±16.1 | 0.88 |

[a]Values are in μM and represent an average of three experiments. The variance for the relative viability (%) and relative SEAP activity (%) values was less than ± 20%. Activity of $P_{hTERT}$-SEAP (hTERT-BJ1) cell growth was significantly different from that of the control; $n = 3$ or more, $P < 0.05$. Relative percentage of inhibition was not compared with that of the control, $P < 0.01$, mean ± S.E., $n = 4$. Values are mean percent activity at the indicated concentration, and standard errors. [b]The hTERT immortalized hTERT-BJ1 was purchased from BD Biosciences Clontech.

Note: The results in this column are shown as means ± SE of experiments repeated five times. The different symbols qualify as in any concentration of treatment: Relative Cell Viability > 80%, Relative SEAP activity > 100% and P value below 0.05 analyzed with Two-tail T-test. The ratio of relative cell viability under relative SEAP activity is over 1.2. All of SEAP data are shown as the result that drug-self interference has been subtracted.

Table 14. Effects of Symmetrical 1,4-diamidoanthraquinones ($VI_{1-37}$) on Repressing hTERT Expression

| No. | R | Conc ($\mu$M)[a] | $P_{hTERT}$-SEAP (hTERT-H1299)[b] Relative MTT viability (%) | Relative SEAP activity (%) | SEAP/vibility |
|---|---|---|---|---|---|
| $VI_1$ | $CH_2Cl$ | 2.5 | 104±5.5 | 102±5.3 | 0.98 |
| | | 25 | 96±3.8 | 110±8.8 | 1.14 |
| | | 255 | 21±1.5 | 97±7.1 | 4.66 |
| $VI_7$ | $(CH_2)_2Cl$ | 2.3 | 99±6.0 | 87±2.3 | 0.88 |
| | | 23 | 68±2.4 | 87±3.1 | 1.28 |
| | | 238 | 30±3.8 | 68±5.3 | 2.30 |
| $VI_9$ | $CH(Cl)CH_3$ | 2.3 | 111±5.5 | 106±5.5 | 0.96 |
| | | 23 | 77±3.4 | 109±1.0 | 1.40 |
| | | 238 | 11±1.4 | 85±5.3 | 7.82 |
| $VI_{33}$ | $CH_2N(CH_2CH_3)_2$ | 2.1 | 105±4.9 | 98±3.3 | 0.94 |
| | | 21 | 87±3.9 | 86±7.4 | 0.99 |
| | | 215 | 44±2.7 | 48±2.3 | 1.11 |
| $VI_{34}$ | $(CH_2)_2N(CH_2CH_3)_2$ | 2.0 | 92±6.1 | 73±2.7 | 0.79 |
| | | 20 | 11±2.5 | 53±2.7 | 4.63 |
| | | 203 | 1±2.4 | 39±0.8 | 44.24 |
| $VI_{35}$ | $CH(CH_3)N(CH_2CH_2)_2$ | 2.0 | 96±7.9 | 96±14.3 | 1.00 |
| | | 20 | 77±7.2 | 104±6.0 | 1.35 |
| | | 203 | 75±4.6 | 73±11.7 | 0.98 |
| $VI_{36}$ | $CH(CH_2)NCH_2CH(CH_2)_2$ | 2.0 | 106±4.1 | 123±12.4 | 1.16 |
| | | 20 | 64±5.1 | 112±11.5 | 1.76 |
| | | 204 | 30±4.7 | 80±14.5 | 2.71 |
| $VI_{37}$ | $(CH_2)_2NCH_2CH(CH_2)_2$ | 2.0 | 108±7.8 | 95±4.2 | 0.88 |
| | | 20 | 83±1.6 | 91±8.9 | 1.09 |
| | | 204 | 67±9.8 | 52±4.4 | 0.77 |
| $VI_3$ | $CH_3$ | 3.1 | 109±3.5 | 85±2.3 | 0.78 |
| | | 31 | 108±3.6 | 90±3.3 | 0.83 |
| | | 310 | 37±1.3 | 80±3.1 | 2.16 |
| $VI_{21}$ | cyclopropane | 2.6 | 95±4.2 | 108±4.9 | 1.14 |
| | | 26 | 88±4.2 | 106±7.3 | 1.21 |
| | | 267 | 41±4.6 | 92±5.9 | 2.23 |
| $VI_{20}$ | cyclopentane | 2.3 | 107±6.1 | 119±8.5 | 1.11 |
| | | 23 | 103±6.1 | 118±9.2 | 1.15 |
| | | 233 | 92±8.6 | 113±8.9 | 1.23 |
| $VI_{17}$ | cyclohexane | 2.1 | 104±6.4 | 104±1.8 | 1.00 |
| | | 21 | 96±5.8 | 100±6.2 | 1.05 |
| | | 218 | 67±1.5 | 93±2.5 | 1.38 |
| $VI_{19}$ | $(CH_2)_2CH(CH_2)_4$ | 2.0 | 105±2.1 | 111±9.4 | 1.06 |
| | | 20 | 106±4.7 | 116±8.0 | 1.09 |
| | | 205 | 95±1.3 | 109±9.2 | 1.15 |

| | | | | | |
|---|---|---|---|---|---|
| $VI_{22}$ | 2-$SC(CH)_3$ | 2.1 | 108±3.7 | 100±3.1 | 0.93 |
| | | 21 | 107±8.5 | 105±5.9 | 0.98 |
| | | 218 | 84±4.3 | 97±4.9 | 1.16 |
| $VI_{24}$ | 2-$OC(CH)_3$ | 2.3 | 101±6.0 | 99±7.8 | 0.99 |
| | | 23 | 75±3.9 | 97±4.6 | 1.30 |
| | | 234 | 32±5.1 | 90±2.9 | 2.83 |
| $VI_{25}$ | $CH_2$-2-$SC(CH)_3$ | 2.0 | 104±8.0 | 111±3.7 | 1.06 |
| | | 20 | 83±6.6 | 115±4.3 | 1.39 |
| | | 205 | 41±4.0 | 102±5.5 | 2.47 |
| $VI_4$ | $C_6H_5$ | 2.2 | 109±6.0 | 81±3.3 | 0.74 |
| | | 22 | 88±6.2 | 84±2.6 | 0.96 |
| | | 224 | 27±1.8 | 80±2.7 | 2.99 |
| $VI_6$ | 3-$CH_3C_6H_4$ | 2.1 | 101±5.6 | 107±4.6 | 1.06 |
| | | 21 | 97±6.2 | 104±4.0 | 1.08 |
| | | 210 | 83±7.8 | 99±9.1 | 1.20 |
| $VI_{10}$ | 2-$FC_6H_4$ | 2.0 | 116±2.4 | 105±7.8 | 0.91 |
| | | 20 | 104±6.1 | 107±11.9 | 1.03 |
| | | 207 | 77±2.6 | 103±14.4 | 1.34 |
| $VI_{12}$ | 3-$FC_6H_4$ | 2.0 | 105±6.8 | 102±2.9 | 0.98 |
| | | 20 | 96±7.4 | 110±6.5 | 1.14 |
| | | 207 | 66±5.5 | 106±9.4 | 1.59 |
| $VI_{30}$ | 4-$FC_6H_4$ | 2.0 | 110±5.9 | 111±3.6 | 1.01 |
| | | 20 | 103±6.6 | 107±4.8 | 1.04 |
| | | 207 | 89±6.7 | 107±9.0 | 1.20 |
| $VI_2$ | 2-$ClC_6H_4$ | 1.9 | 114±5.4 | 108±10.5 | 0.94 |
| | | 19 | 72±3.6 | 105±7.7 | 1.47 |
| | | 194 | 60±7.9 | 100±8.9 | 1.68 |
| $VI_5$ | 3-$ClC_6H_4$ | 1.9 | 95±11.3 | 110±4.9 | 1.17 |
| | | 19 | 102±8.5 | 112±6.1 | 1.10 |
| | | 194 | 59±4.3 | 91±3.0 | 1.55 |
| $VI_{16}$ | 4-$ClC_6H_4$ | 1.9 | 89±5.5 | 109±6.8 | 1.23 |
| | | 19 | 89±9.5 | 118±5.6 | 1.33 |
| | | 194 | 79±5.6 | 116±12.3 | 1.46 |
| $VI_{11}$ | 2-$NO_2C_6H_4$ | 1.8 | 104±6.3 | 105±4.3 | 1.00 |
| | | 18 | 101±4.1 | 107±7.9 | 1.06 |
| | | 186 | 86±5.3 | 94±8.0 | 1.10 |
| $VI_{31}$ | 2-$CF_3C_6H_4$ | 1.7 | 98±7.8 | 110±5.5 | 1.12 |
| | | 17 | 100±8.9 | 114±5.6 | 1.14 |
| | | 171 | 77±6.7 | 96±2.1 | 1.24 |
| $VI_{29}$ | 2,3-$(CF_3)_2C_6H_3$ | 1.3 | 99±8.6 | 106±6.7 | 1.07 |
| | | 13 | 79±10.3 | 105±7.9 | 1.32 |
| | | 139 | 37±8.8 | 94±10.2 | 2.56 |
| $VI_{18}$ | 2,4-$F_2C_6H_3$ | 1.9 | 87±3.7 | 93±5.6 | 1.06 |
| | | 19 | 85±7.1 | 99±5.4 | 1.17 |
| | | 192 | 69±8.4 | 99±1.8 | 1.44 |
| $VI_8$ | 2,4-$Cl_2C_6H_3$ | 1.7 | 106±3.9 | 85±7.9 | 0.80 |
| | | 17 | 95±1.3 | 84±7.1 | 0.89 |
| | | 171 | 83±1.2 | 87±2.6 | 1.06 |

| | | | | | |
|---|---|---|---|---|---|
| $VI_{13}$ | 2,4,6-$Cl_3C_6H_2$ | 1.5 | 113±4.8 | 98±4.5 | 0.87 |
| | | 15 | 107±5.4 | 66±2.4 | 0.61 |
| | | 153 | 20±3.3 | 41±3.9 | 0.03 |
| $VI_{14}$ | 2,3,6-$F_3C_6H_2$ | 1.8 | 111±2.9 | 91±5.2 | 0.82 |
| | | 18 | 89±3.7 | 97±4.1 | 1.09 |
| | | 180 | 55±3.3 | 91±3.3 | 1.64 |
| $VI_{15}$ | 2,4,5-$F_3C_6H_2$ | 1.6 | 90±6.6 | 109±10.8 | 1.20 |
| | | 16 | 81±1.9 | 118±10.3 | 1.45 |
| | | 161 | 60±5.0 | 104±8.2 | 1.73 |
| $VI_{23}$ | 2,3-$Cl_2$-5-$FC_6H_2$ | 1.6 | 98±7.0 | 102±4.1 | 1.04 |
| | | 16 | 103±8.7 | 102±5.1 | 0.99 |
| | | 161 | 87±5.1 | 83±4.0 | 0.95 |
| $VI_{27}$ | $CH(CH_2)CHC_6H_5$ | 1.8 | 101±2.4 | 95±7.7 | 0.94 |
| | | 18 | 100±4.7 | 93±3.2 | 0.93 |
| | | 189 | 94±3.5. | 87±3.6 | 0.92 |
| $VI_{28}$ | $CH_2SC_6H_5$ | 1.8 | 104±5.6 | 93±3.2 | 0.89 |
| | | 18 | 96±4.3 | 92±3.5 | 0.96 |
| | | 185 | 59±3.8 | 80±4.0 | 1.35 |
| $VI_{32}$ | $CH_2$-4-$FC_6H_4$ | 1.9 | 108±8.8 | 109±10.8 | 1.00 |
| | | 19 | 107±7.5 | 109±5.8 | 1.03 |
| | | 195 | 78±8.0 | 109±6.6 | 1.39 |
| $VI_{26}$ | 2,5-dimethylfuran | 2.0 | 87±4.9 | 104±10.8 | 1.20 |
| | | 20 | 71±2.3 | 103±10.0 | 1.46 |
| | | 207 | 47±2.6 | 98±10.5 | 2.10 |
| | Mitoxnatrone | 1.9 | 100±5.6 | 81±3.8 | 0.82 |
| | | 19 | 57±4.3 | 66±4.0 | 1.16 |
| | | 193 | 39±3.2 | 47±3.9 | 1.21 |

[a]Values are in μM and represent an average of three experiments. The variance for the relative viability (%) and relative SEAP activity (%) values was less than ± 20%. Repression of $P_{hTERT}$-SEAP (hTERT-H1299) cell growth was significantly different from that of the control; $n = 3$ or more, $P < 0.05$. Relative percentage of inhibition was not compared with that of the control, $P < 0.01$, mean ± S.E., $n = 4$. Values are mean percent activity at the indicated concentration, and standard errors. [b]The hTERT cancer cell hTERT-H1299 was purchased from BD Biosciences Clontech.